Chap10_rev_10-37

Replace the section on pg. 357 from (10-36) to (10-38) with the following.

$$\tilde{\mathscr{M}} = \begin{bmatrix} m_\nu & 0 \\ 0 & M \end{bmatrix}. \tag{10-36}$$

Consider a diagonal neutrino mass matrix

As noted earlier, all neutrinos then must be Majorana, and since for them, as can be seen from Wholeness Chart 10-1, pg. 353, if particles are the same as antiparticles,

$$\nu_L^c = \nu_R \qquad \bar{\nu}_L^c = \bar{\nu}_R \qquad\qquad \nu_R^c = \nu_L \qquad \bar{\nu}_R^c = \bar{\nu}_L . \tag{10-36)+1}$$

Then, (10-33) becomes (with wavy underlines to distinguish the more massive neutrino from the less massive one and a notation change in the second line to that commonly found elsewhere)

$$\begin{aligned} \mathcal{L}_{\substack{mass\\terms}} &= -\frac{m_\nu}{2}\left(\bar{\nu}_L \nu_L^c + \bar{\nu}_L^c \nu_L\right) - \frac{M}{2}\left(\bar{\underset{\sim}{\nu}}_R \underset{\sim}{\nu}_R^c + \bar{\underset{\sim}{\nu}}_R^c \underset{\sim}{\nu}_R\right) = -\frac{m_\nu}{2}\left(\bar{\nu}_L \nu_R + \bar{\nu}_R \nu_L\right) - \frac{M}{2}\left(\bar{\underset{\sim}{\nu}}_R \underset{\sim}{\nu}_L + \bar{\underset{\sim}{\nu}}_L \underset{\sim}{\nu}_R\right) \\ &= -\frac{m_\nu}{2}\bar{\nu}\nu - \frac{M}{2}\bar{\underset{\sim}{\nu}}\underset{\sim}{\nu} = -\frac{m_\nu}{2}\bar{\nu}\nu - \frac{M}{2}\bar{N}N = -\frac{1}{2}\left(\bar{\nu} \;\; \bar{N}\right)\tilde{\mathscr{M}}\begin{pmatrix} \nu \\ N \end{pmatrix}. \end{aligned} \tag{10-37}$$

yields Lagrangian mass terms expressed via two new kinds of neutrinos, ν and N

ν and N are the fields directly coupled to the Higgs. The eigenstates are then

$$\tilde{V}_1 = \begin{pmatrix} \nu \\ 0 \end{pmatrix} \qquad\qquad \tilde{V}_2 = \begin{pmatrix} 0 \\ N \end{pmatrix}. \tag{10-38}$$

Eigenvectors of this diagonal mass matrix